Weatherwise

Volume 6, Number 1 February 1953

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE" — BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

DAVID M. LUDLUM, *Editor*
HENRY W. BULKLEY, *Associate Editor*
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ERIC SLOANE, *Art Director*

AMS CALENDAR

The American Meteorological Society plans a full schedule of meetings in 1953 that will carry its activities to the far corners of the country and to Canada. All readers of WEATHERWISE, who are not members of the AMS, are invited to attend.

NEW YORK CITY, January 26–29. The 120th National Meeting since the founding of the society in 1919 will take place in conjunction with the meetings of the Institute of Aeronautical Sciences. The annual business meeting will be held on January 28. The Hotel Roosevelt will serve as headquarters.

ATLANTIC CITY, March 17–19. Panel discussions will feature four main topics: numerical prediction, climatology, long-range forecasting and ice islands. Headquarters will be at the Chalfont-Haddon Hall.

WASHINGTON, D. C., April 29–May 4. The annual spring meeting at the Nation's Capital will include joint meetings with the American Physical Society and the American Geophysical Union. The AMS sessions have been scheduled to be held at the National Archives building.

SANTA BARBARA, CAL., June 16–18. As usual, the AMS sessions will be held in conjunction with the meetings of the Pacific branch of the American Association for the Advancement of Science.

TORONTO, CANADA, September 9–15. A full week's program will take place in connection with the meetings of the Royal Meteorological Society. The Canadian Meteorological Service will serve as hosts.

AUSTIN, TEXAS, November 9–12. The meetings will be devoted, in general, to the subject of radio meteorology with the local seminar of the AMS serving as hosts.

BOSTON, MASS., December 29–30. The final meeting of 1953 will be held in conjunction with the national meeting of the American Association for the Advancement of Science.

OUR EDITOR

This issue marks the commencement of the sixth volume of WEATHERWISE. For the first time, we do not have the benefit of the skill and experience of Charles A. Federer, Jr., in the editor's chair. The demand of other duties in connection with the defense program has forced Mr. Federer to divest himself of some of his editorial activities.

The acceptance won by WEATHERWISE as a popular weather magazine during the past five years has largely been the result of the care and energy that he and his wife, Helen, have put into the job. We regret losing them and wish them well in their new responsibilities.

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Cover: Ore tankers, lead by a harbor tug, are attemping to smash their way through slush ice in Buffalo harbor in an effort to open the navigation season. Photo taken from a U. S. Coast Guard plane.

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Lake gale of 50 mph. batters the shoreline of Milwaukee during an early season storm on October 7, 1948. Wide World photo.

Great Lakes Weather

R. E. LAUTZENHISER, *U. S. Weather Bureau, Chicago*

THE Great Lakes lie in the midst of a favorite battleground where clashes between cold air masses from northern continental regions and warm air masses from the tropical Gulf of Mexico often take place. Cold air masses predominate in winter, but give way more frequently to tropical masses in summer. The frequent changes in any season make a visitor to the Midwest likely to hear the old and overworked conversation piece, "If you don't like our weather, just wait a few hours or minutes." When this joke is used in the Great Lakes region, the implication often is that the expansive bodies of water are responsible. Since the Great Lakes, together with numerous appendages, make up a total water surface equal to that of a square lake 300 miles on a side, it is to be expected that weather and climate will be affected. Sometimes the effects are sudden and dramatic along some shores, yet the overall weather picture is much like it would be if the Lakes were not present since most changes in day to day weather are due to extensive air mass changes, common to the whole Midwest.

The Lakes warm slowly in summer and cool slowly in winter. Even in the coldest winters they do not entirely freeze over, so that the minimum temperature for most of the area is no lower than 32° F. In summer the surface of Lake Superior warms only to the 50's, but the southern waters of Lake Erie and southern Lake Michigan reach water temperatures in the low 70's.

The most spectacular effects of the Lakes occur when very cold polar continental air crosses them in a cyclonically curved flow in late fall or early winter. In this season a temperature differential of 40 degrees or more may be produced with the warmer lake water heating and humidifying the surface layers of cold air. This results in turbulent convection currents which build higher and higher, depending on the time the air spends in its trajectory over the open water. "Great Snows of the Great Lakes" by B. L. Wiggin (see WEATHERWISE, December, 1950) treats in a very interesting manner the regular snows and occasional snowbursts that fall along the shores over which the moistened and heated air drifts, nearly always on the southern or eastern shores.

In addition to causing excessive snowfall to the lee of the Lakes, the newly-formed super-

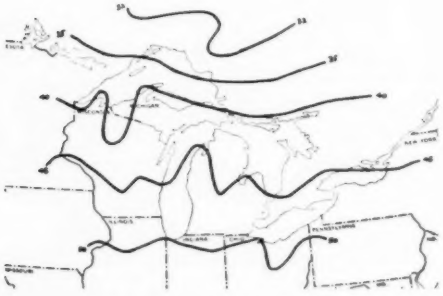
Wind damage in the Chicago area during the Armistice Day storm of 1940. Chicago Daily news photo.

cooled water droplets from the clouds are carried in the convective currents over much of the New York-Chicago airway, making aircraft icing a formidable problem for the pilot. Some experienced fliers say that the icing problem on flights east of Chicago is more serious than that for a flight across the North Pole.

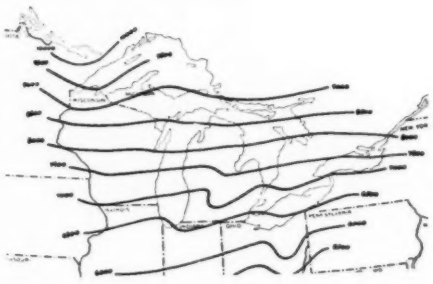
The same elements, however, that trouble the pilot or the snowbound motorist are blessings to the fruitgrowing industries that thrive along the southern and eastern shores of the Lower Lakes, especially. Not only are the worst cold waves tempered to the lee of the Lakes, but the slow warming in the spring holds back fruit bloom dates until the worst danger of a killing frost is past.

The air mass that is most modified by the Lakes and causes the most local weather in winter, polar continental, is affected very little in summer. The air warms on the way southeastward across Canada so that the difference between the air and the water is at a minimum. The air currents that are least affected throughout the year are maritime air masses from the Pacific, which are of a moderate character originally and do not show extreme contrast to existing Lake conditions. Tropical air from the Gulf is little changed in winter, as it will have cooled in its northward travel sufficiently that little contrast remains. In summer, however, and particularly in spring when the Lakes are quite cool, the air may be many degrees warmer than the water. Cooling by the water surface prevents heat waves from reaching the northern and eastern shores, and the same cooling will cause heavy fog or low stratus to develop if the moisture content of the Gulf air is sufficiently high.

The most changeable weather element is the lake breeze and its accompanying sudden temperature drop. This phenomenon is felt only near the shore, seldom more than 10 miles inland. Since the prevailing direction of the wind over most of the area is from southerly or westerly quadrants, in spring and



Average annual temperature, F°.



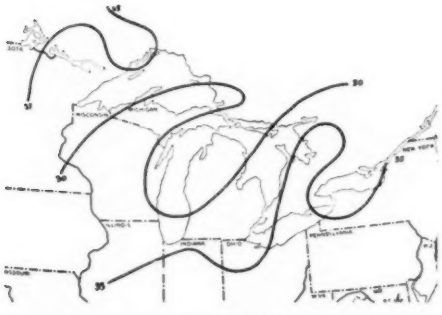
Average number of degree days.

summer when the land becomes warm, the Lakes cool the lower layer of air, which contracts and becomes heavier than the warmer land air. On days when the prevailing winds are not too strong, the cold heavy air will wedge in underneath the warm air, forming a shallow lake wind along the western and southern shores. The front of the wedge may penetrate either a short distance inland or several miles, depending mainly on the temperature difference and the strength of the prevailing wind; at the front a temperature change from sweltering heat to cool comfort may exist. The front sometimes wavers back and forth, so a person may experience several sudden changes on the same day if he is located at the critical distance inland. On the opposite shores, the lake effect serves only to strengthen the prevailing winds. In fall and winter, the direction of the local breeze is reversed, causing the prevailing winds to strengthen on the western shores and to weaken or reverse themselves on the opposite side.

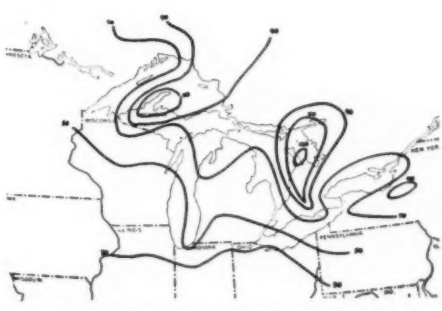
Many years ago, H. J. Cox, then in charge of the Chicago Forecast Center, in a study of the influences of the Great Lakes, showed that the relatively cool waters in warm weather caused a rise in the average barometric pressure over that of the surrounding area, most marked in the spring when the water is coolest in relation to the average air temperature. Also a persistently lower pressure occurs in winter due to the relative warmth of the Lakes. Cox found that the movement of highs and lows tended to be steered to or away from the Lakes area according to the season. Highs that reached the district tended to be strengthened in summer and weakened in winter. Similarly, lows tended to deepen in winter and fill in summer. This may account for the unusual number of clear days enjoyed by Lake cities in the spring and the large number of cloudy days experienced in wintertime.

The climate of the Great Lakes area is classified as continental, humid microthermal. The mean annual temperature ranges from just above 32° F. to the north of Lake Superior to near 50° F. in the south along the Chicago-Cleveland line. There is no dry season, but agriculture benefits from the greater share of the annual precipitation falling in the spring and summer months. Total annual amounts range from near 25 inches in the northwest to near 35 inches in the south and east. The increase in the south and east is mostly due to those areas being nearer the streams of moist Gulf air from which most of the area's precipitation comes. Only in wintertime, when the lake snows may be appreciable, is the surface water an important source of moisture for precipitation.

The northern portion of the Great Lakes enjoys cool summers, making the tourist trade one of the important industries. Only in the southern third of the area is summer heat sufficient to warrant extensive use of air conditioners. In the populous cities there, many are prone to blame the Lakes unjustly for the uncomfortable summer humidity. Actually, the Lakes affect summertime humidity but little, and residents fare no worse than other Midwesterners. The abundance of water available for industrial and transportation uses, however, has allowed the tremendous development of heavy industry, including steel and chemical production. On days with light winds or a persisting temperature inversion, smoke or fumes may accumulate sufficiently to cause in susceptible persons symptoms of



Average annual precipitation in inches.



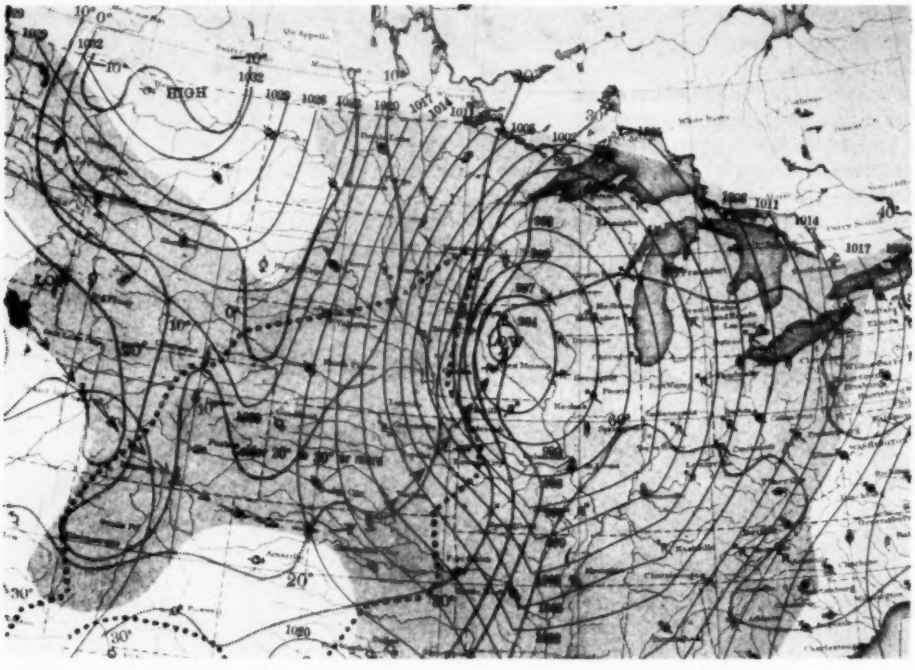
Average annual snowfall in inches.

discomfort, which are wrongly blamed on the humidity.

Prof. E. B. Garriott once analyzed all the large-scale storms of sufficient strength to threaten shipping on the Great Lakes over a period of 25 years. With an average of nearly 10 storms per year, the seasonal distribution showed that November was the month most susceptible with two per year; July is the least, with only one storm in four years.

Probably the most destructive storm in modern history of the Great Lakes occurred on Armistice Day, 1940. The storm center, after crossing the Rockies, had recurved northeastward from the Kansas-Oklahoma area and reached its lowest sea level pressure in the United States, 28.57 inches, at Houghton, Michigan, at 6:30 p.m. on the 11th, when the center was located a short distance west. The strongest wind recorded by a Weather Bureau station occurred at Grand Rapids, Michigan, with a 5-minute average of 65 miles per hour from the southwest. Gales blew on all the Lakes, but damage on Huron, Erie, and Ontario was confined mostly to small craft. Lake Michigan was hit the worst with three steamers and many small boats sunk and a loss of life that reached 69 persons. The southwesterly gales lowered the water level by 4.8 feet at Chicago with nearly a correspondingly large rise at the northern end. Though a ship captain on Lake Superior stated that the storm was the worst in his 40 years career on the Lakes, shipping losses there were comparatively light with no fatalities reported.

The Armistice Day Storm, as it is now known, was born of the very great contrast between air masses that are always part and parcel of Great Lakes weather and, in fact, of all the great Middle Western area. The Lakes had little influence in creating a storm of this size, though those who felt its fury from the storm-tossed deck of a ship must have thought the Lakes entirely responsible.



Daily weather map for 6:30 a.m., CST, November 11, 1940. Low is centered in central Iowa with a pressure reading of 984 mb (29.06 inches). An extremely cold air mass is poised near the Canadian border with a mercury reading of − 10° F. at Williston, North Dakota. The cold front has already reached Missouri and is causing further intensification of the storm. By 6:30 p.m. pressure readings were down to 967 mb (28.57 inches) near Marquette, Michigan, and gales were experienced on all the Lakes. USWB map.

A typical ore boat, the John T. Hutchinson of the Buckeye Steamship Company, fights ice floes. Lake Carriers Association photo.

ICE REPORTING ON THE GREAT LAKES

W. W. OAK and H. V. MYERS
U. S. Weather Bureau, Detroit

THE Great Lakes are the busiest inland waterways of the world. During the past 10 years the average annual tonnage of shipping has exceeded 200 million long tons, which were carried in over 700 vessels of American and Canadian registry. Iron ore, alone, in 1951 accounted for 90 million tons or approximately 80 percent of all the iron ore used in the United States that year. Since this shipping is so vital to our national economy, the length and character of the navigation season on the Lakes is of fundamental importance to all heavy industry. During the winter, ice conditions usually force a cessation of shipping activities for about four months, and then stockpiles can become dangerously low and sometimes completely depleted by a delayed opening of the navigation season.

The latitudinal separation of the northernmost and southernmost ports of the Great Lakes is approximately 500 land miles with mean January temperatures ranging from a 10° average over northern Lake Superior to near 30° along the southern Lake Erie shore. By late October or early November, some ice will form in the slips at the northern ports, but it is usually the latter part of November or early December before traffic materially decreases. By December 15th practically all shipping ceases until spring.

Owing to their great depths, which with a single exception reach below sea level, none of the Lakes, except possibly the shallow Lake Erie, ever freeze over from shore to shore. Ice ranging from a few inches to three feet or more in thickness builds out from the shorelines, and much of it breaks off into fields and floes, which shift with the wind and may at times cover 60 to 90 percent of the surface. High winds cause the fields to form pressure ridges and windrows; some extend 10 to 20 feet above water and 30 to 35 feet below and often become anchored to the lake bottom.

Ice of greatest thickness forms in the more protected bay areas: notably, Big Thunder Bay, the Duluth-Superior area, Chequamegon Bay, Green Bay, the De Nocs, Georgian Bay and Saginaw Bay. The shallow waters in the island areas of northern Lake Michigan, western Lake Erie and northeastern Lake Ontario, likewise, favor heavier ice formation. Areas which usually experience the greatest difficulty from windrows as a result of prevailing winds and lake currents are: Whitefish Bay and the upper St. Marys in Lake Superior, the island area of northern Lake Michigan, the Straits of Mackinac and the extreme eastern end of Lake Erie. The connecting waterways of the lower St. Marys River and the St. Clair River are subject to ice gorges.

Measurements of ice thicknesses at the close of winter have ranged up to maxima of 41 inches at Port Arthur, 38 inches at Duluth, 27 inches at Sault Ste. Marie, 35 inches at

Escanaba, 30 inches at Green Bay, the Straits of Mackinac and Alpena, 35 inches at Saginaw Bay, 17 inches at Cleveland, 21 inches at Buffalo, and 25 inches at Oswego and Kingston.

About the middle of February, the Weather Bureau activates its ice reporting program to assist the carriers in planning and outfitting for the opening of navigation. Through the cooperation of the Canadian Meteorological Service, U. S. Coast Guard, U. S. Hydrographic Office, airline pilots plus other agencies and individuals, approximately 120 reporters forward information regarding ice thickness, extent of areal coverage, amount of windrowing and degree of deterioration for inclusion in weekly bulletins prepared in the Detroit office and distributed through direct mailing lists, trade journals and newspapers. Daily reports from major ports and strategic areas are included in Weather Bureau teletype collections and are made available to shipping interests at all Lake Weather Bureau offices.

Ice reports contain several descriptive terms of special significance. *Hard blue ice* refers to ice showing no signs of deterioration, having a distinguishing blue color indicating little or no snow content. *Snow ice* is that which is white in appearance indicating it to be partly composed of packed and congealed snow; it is less resilient than blue ice. *Honeycombed* refers to ice that has undergone deterioration through infiltration by water and foreign matter, leaving it porous and in a needle-like state, and such ice is easily broken. *Slush ice* is frozen matter that has become well broken up by winds, waves and pressure crushing effect. When it extends well below the water surface and is displaced by a vessel, it tends to move in quickly and surround it, preventing movement in any direction, and is likely to damage propellers and steering gear or to fill condenser intakes. Slush ice is considered the most treacherous and difficult form of ice to encounter and combat because it forms an impenetrable barrier that defies even ice breakers, sometimes trapping and holding vessels for a week or more. Whitefish Bay and the outlet end of Lake Erie are probably the most critical areas for accumulation of

OPENING DATES OF NAVIGATION

and

the preceding February's mean temperature

	Earliest		Latest	
Buffalo	March 14, 1951	(27.4°)	May 9, 1926	(21.9°)
Cleveland	March 1, 1937	(30.9°)	April 17, 1885	(16.8°)
Toledo	Open: 1949	(25.6°)	April 15, 1904	(17.9°)
	1950	(32.4°)	April 15, 1926	(28.0°)
Detroit	March 1, 1890	(32.4°)	April 17, 1885	(17.2°)
	March 1, 1932	(33.0°)		
	March 1, 1937	(28.2°)		
Sault Ste. Marie	March 22, 1942	(14.8°)	May 1, 1893	(9.1°)
			May 1, 1923	(8.8°)
			May 1, 1928	(11.2°)
Marquette	March 25, 1932	(21.8°)	May 16, 1917	(6.4°)
	March 25, 1942	(20.2°)		
Duluth	March 1, 1911	(16.6°)	May 12, 1875	(−2.1°)
Green Bay	March 28, 1942	(20.0°)	May 4, 1904	(6.6°)

	1950		1951		1952	
Buffalo	April 6	(24.8°)	March 14	(27.4°)	March 27	(29.1°)
Cleveland	March 13	(30.4°)	March 2	(29.9°)	March 11	(32.1°)
Toledo	Open	(32.4°)	March 9	(27.6°)	March 11	(30.4°)
Detroit	March 14	(26.5°)	March 3	(27.7°)	March 12	(29.3°)
Sault Ste. Marie	April 23	(14.0°)	April 2	(17.2°)	April 2	(19.7°)
Marquette	May 2	(19.3°)	April 9	(19.6°)	April 5	(23.4°)
Duluth	May 2	(14.8°)	April 11	(12.9°)	April 5	(19.3°)
Green Bay	April 14	(16.8°)	April 4	(17.5°)	April 10	(22.2°)

The $10 million icebreaker Mackinaw, the most powerful ship of its type in the world, breaks a path for seagoing freighters through the St. Marys River. Fitted with a bow propeller and a formidable prow, the Mackinaw can break a path through solid, thick ice at 10 knots. U. S. Coast Guard photo.

slush ice, the important port of Buffalo often being among the latest to open to navigation.

When reports indicate ice conditions have reached the stage where icebreakers can be used effectively, the "Mackinaw," mightiest of all such vessels with her great weight, wide beam, heavy steel plating, heeling tanks and 10,000 horsepower, together with several smaller cutters, is placed in operation by the Coast Guard. Working in conjunction with helicopters which survey the ice fields, these vessels break out harbors, clear waterways, and usually convoy ships at the opening of the season.

Since our economic welfare is so dependent on our Great Lakes commerce, it is obviously important that operators be ready to move vessels at the earliest possible date. The Lake Carriers Association estimates that, even considering the rigors and retarded operations of early season, a minimum of one million tons of iron ore can be gained per week if vessels are ready to operate immediately when navigation is feasible. To fit out the fleet prematurely would entail an unnecessary operating expense of $400,000 to $500,000 per day.

To assist in pre-opening planning, the Detroit Weather Bureau office examined nearly 50 years of records in an attempt to correlate preceding winter temperatures with subsequent spring opening dates. A significant correlation was obtained through using a summation of December, January and February mean temperatures, but further investigation showed that better results could be obtained through use of February temperatures alone. Forecast curves were developed for Duluth, Marquette, Sault Ste. Marie, Green Bay, Detroit, Toledo, Cleveland and Buffalo. These curves have been used to advantage at the beginning of the seasons of 1951 and 1952.

The opening date of navigation at any port is customarily considered as the date the first cargo vessel arrives. At some ports, particularly Buffalo, this arrival does not necessarily mean navigation is fully open for the season since subsequent shifting of ice fields may close a port or entrap vessels enroute. In our

study only the final opening date has been considered.

A study of initial vessel movements of previous years disclosed four primary factors determining the opening of navigation: (1) Ice thickness and condition. (2) Economic factors. (3) Open winters. (4) Effective date of insurance and seasonal rates.

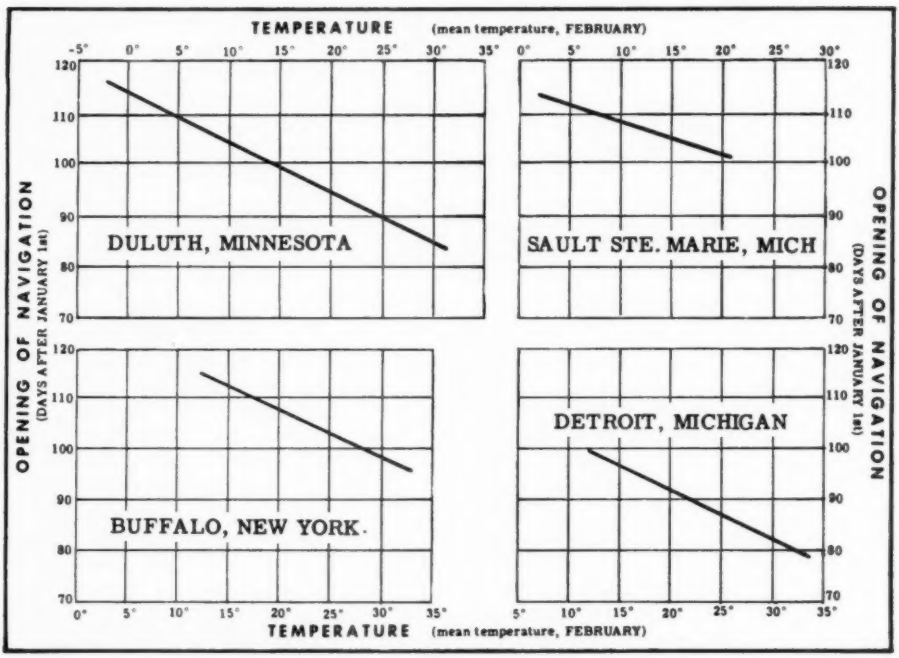
We have attempted to eliminate the outstanding examples of economic pressure, such as the early war years, from our consideration. The factor of open winters was handled by not including the years of particularly free navigation. And the fourth factor, insurance conditions, has been treated as an invariable, and no allowance made therefor.

In order for our figures to be of forecast value, it is not practical to include March temperatures even though there are undoubtedly some instances where March figures may advance or retard computed dates. In several test cases, however, we found March conditions had much less influence than expected. High winds, which break up the heavily windrowed, hard, blue ice, appear to be more influential in delaying openings than below normal March temperatures.

The standard error of the estimated opening date of navigation varied from eight days at Cleveland to 13 days at Duluth. Since Sault Ste. Marie is one of the strategic points, it is gratifying to find the low tolerance of eight days at that port. Forecasting graphs are shown for Duluth, Sault Ste. Marie, Detroit and Buffalo. As an example, if on March 1st, it is found that the February mean temperature at Duluth was 16.5° F., then the graph would forecast the date of opening to be 98 days after January 1st, or April 8th. The standard error of estimate for Duluth is 13 days, so the opening date in two-thirds of the years would be within the tolerance of 13 days.

During the two years the graphs have been in use, their application has shown better results for the northern ports. This is not too disconcerting in view of the fact that early fleet operations are governed by northern ports.

Considering the numerous factors involved, it is believed that the results are within satisfactory limits for a four to six weeks advance forecast as of March 1st, and are basically sound enough for preliminary planning. Subsequent developments which are given in the detailed ice reports can then be used to estimate more closely the actual dates of opening.



A LETTER FROM KOREA

Dear Editor:

When the Communist forces in Korea first overran that country more than two years ago, they completely destroyed, among other things, the entire Korean weather service. Its personnel, both civilian and military, were killed off almost to the last man; their libraries destroyed; and most of the climatic records were burned.

I recently returned from a tour of duty with the Air Force in that war-ravaged land. While there, I had the opportunity to observe first hand some of the remarkable progress these people have made in rebuilding their shattered service over the past two years. Their tiny service is now almost entirely Korean trained, although a few of the older instructors have been to schools in Japan. It is now rapidly expanding into a meteorological organization of which we, as well as the rest of the free world, can be proud.

Never in my life have I seen men more eager to learn, nor more appreciative of the help we have given them, than these Korean meteorologists. I would like to cite the case of a young Korean lieutenant, whose name I would not like to disclose except to call him, "Kim." Kim was assigned to the USAF weather service in Korea, and it was there that I first observed his work and grew to know him. Like many of the ROKAF meteorologists, he can speak English well, and write it acceptably—all of them are college trained. Living under adverse conditions, Kim spent every minute of his time translating our textbooks, manuals, meteorological papers and bulletins into his native Korean. After completing some particular work, he would contact his fellow Korean forecasters in the area. and together they would spend long hours studying and commiting to memory the information before passing it along to others.

Although there are a lot of meteorological works available in Japan, these people have only enough to teach themselves the basic fundamentals of modern meteorology. Except for whatever access they may have to libraries in our weather stations, there is no study material available to them. They need textbooks and old copies of our weather publications very badly.

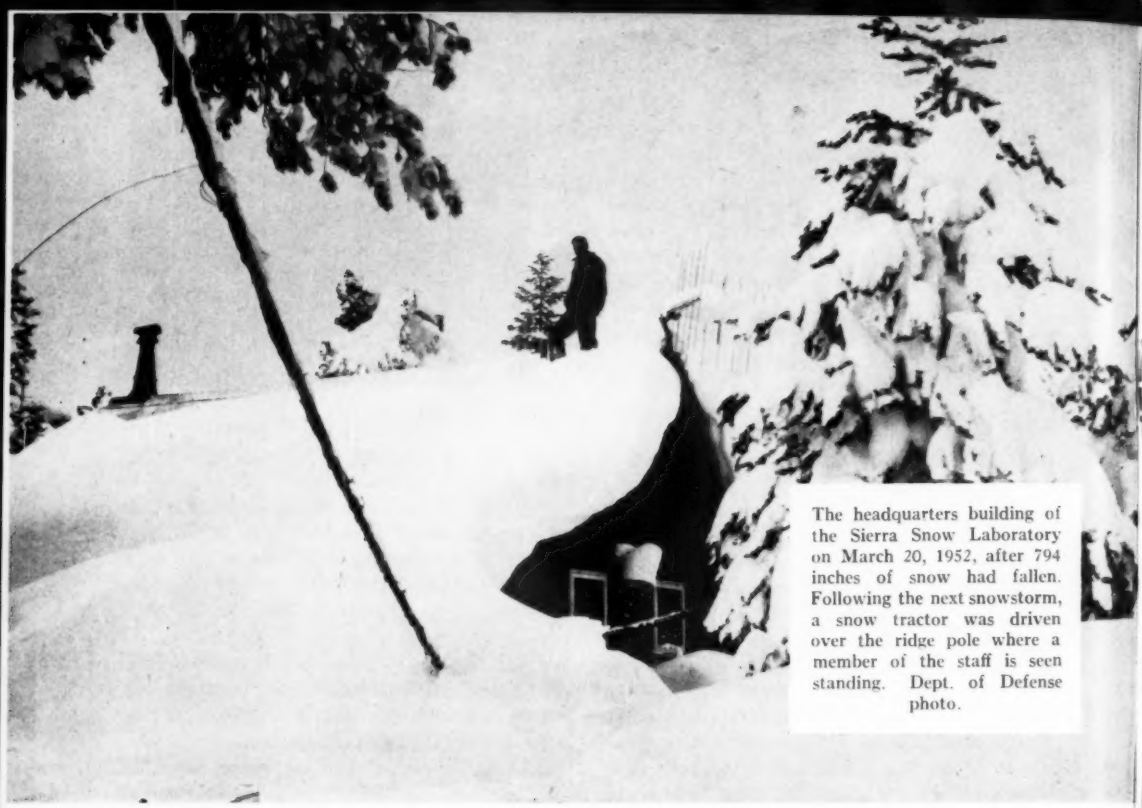
This, of course, leads to the purpose of this letter. I would like to appeal to all members of the American Meteorological Society, the Franklin Institute, and readers of *WEATHERWISE,* as well as scholars throughout the country, to aid by sending textbooks, reference material and any other meteorological publications to the Korean weather service. If you or your readers have old copies of Petterssen, Byers or Starr or monthly publications of a technical or non-technical nature, those men will translate them into Korean, and I can assure you they will be well used.

Part of the mission of the 30th Weather Squadron, Air Weather Service, USAF, is to aid in the rehabilitation of this nearly destroyed weather service of the Republic of Korea. Thus, anyone who wishes to aid them, can do so by sending material to:

Headquarters, 30th Weather Squadron
Attn: Lt. Col. Andrew Paton—Technical Material
A.P.O. 970
c/o Postmaster, San Francisco, California

I regret there are no funds available to pay for postage, but this much I can assure you—whatever you send will reach waiting hands and eager minds.

Very sincerely,
HAROLD E. TAFT, JR.



The headquarters building of the Sierra Snow Laboratory on March 20, 1952, after 794 inches of snow had fallen. Following the next snowstorm, a snow tractor was driven over the ridge pole where a member of the staff is seen standing. Dept. of Defense photo.

THE BIG WINTER OF 1951-52 IN THE HIGH SIERRA

WILLIAM H. PARROTT, *Central Sierra Snow Laboratory*

THERE was no particular indication in the fall of 1951 that the coming snow season was going to be any different from any other snow season, except for the folklore forecasts of the local natives, which are normally of a pessimistic nature calling for a hard winter. These forecasts last year were based on the fact that there was an overabundance of yellow jackets and a great supply of pine cones, all forecasting a severe winter. The scientific staff at the laboratory took these local prophecies in stride, but, as it turned out, the 1951–52 snow season was one of record-breaking proportions, a season that snowbound streamlined transcontinental trains, closed the transcontinental highway for as long as a month, and completely marooned people of high altitude communities for a number of days on several occasions. With modern transportation at a standstill, the only means of moving about were snowshoes, skis, or, if you were very fortunate, snow tractors, even on the main highways.

Snowfall measurements in general can be very misleading unless the procedures are standardized; the method in use at the Central Sierra Snow Laboratory, a field station of the Snow, Ice and Permafrost Research Establishment of the Corps of Engineers, located near Soda Springs, California, makes measurements of new snow which falls on a special snow-board during a 24-hour period. If these measurements are made more frequently, of course, the snowfall value will be greater due to the consolidation of the new snow during the measurement period. To the best of knowledge, the measurements in this area were never in the 82 years of record made more frequently than once in 24 hours.

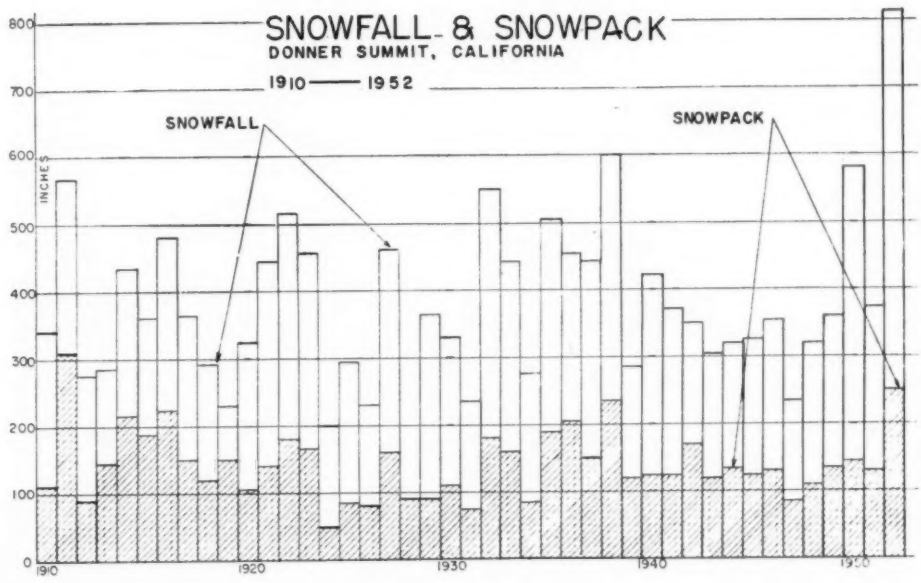
Regardless of how often the measurements were made, the totals at the laboratory last season set an all-time record for the Donner

Summit area in the central Sierras. There were over 800 inches, almost 70 feet, of snowfall at the headquarters station during the 1951–52 season, which commenced on October 23rd with the first falls and closed on June 9th when only a few patches remained. In 1879 and 1889, it was estimated that there were over 700 inches each year, the only two that even approached the total snowfall of the past season. The snowpack depth is again a variable measurement depending mostly on where the sounding is made; the deepest snow depth of the season occurred in March, 1952, and totaled 247 inches, a little over 20 feet. Although this figure was well above average pack depths for the Donner Summit area, it did not set a record since in March, 1911, accumulations measured over 300 inches at nearby localities where records were then maintained.

The distribution of the snowfall during the 1951–52 season was very similar to that of preceding years except for the abnormally heavy snows during the month of March when a little over 160 inches fell. The main accumulation period is usually January, but March snowfall in 1952 was almost two-thirds that of January. The maximum fall during a 24-hour period was 45 inches, and most of this occurred during the night hours. To walk out of your home into 45 inches of new snow is an experience that is hard to forget; it must be similar to finding yourself buried above your waist in sand and trying to walk through it. Under these conditions neither snowshoes, skis nor snow tractors were of much use, and traffic in the entire community was at a standstill.

In previous years the 15-foot gage towers that house the meteorological instruments have always been adequate; but early in 1952, not only the gage towers disappeared, but also the precipitation gages, which are perched on top of the towers a little over 20 feet above ground level, went under the snowy blanket. Overnight snows were so heavy that snow tractors were completely buried, and drivers would find nothing but an open snow field in the morning. If he was fortunate enough to remember where the tractor was left, the driver might locate it with a shovel; otherwise he had to take soundings with a snow tube to locate the buried vehicle.

The accumulated precipitation is normally one of the important climatological variables, but in snow country it is obvious that this variable is in the form of a solid and is not usable water. Total rainfall has been well above normal for the last three years in the Donner Summit area. In 1949 and 1951, the



A precipitation station in the high Sierras. The snow shield of a Sacramento type storage gage can be seen in the snow in the left foreground. The precipitation gage at the right is mounted on a tree stump which was sawed off at approximately 32 feet above the ground. Dept. of Defense photo.

precipitation was mostly in the form of snow, but in 1950 much came as rain early in the season when there was little snow on the ground. This early liquid precipitation caused one of the most severe flood conditions in the last decade in the lowlands of central California. During the 1951–52 snow season, though the accumulated precipitation was greater than in any previous season, there was no serious flood condition experienced in the valley the following spring. The reason, of course, is obvious, for the water was impounded in the mountains in the form of snow and, as pointed out by the cooperative snow investigations of the Corps of Engineers, there has never been a flood here caused entirely by snow melt alone.

The process of melting snow is very slow even under the best conditions in view of the fact that each gram of snow requires 80 calories of heat to turn into water, making a snow field act as a natural control dam. Normally, the roads in the laboratory basin are open and in a usable condition for transportation by the middle of May or the first of June. But due to the slow melt of the immense snow pack, it was necessary to contract for mechanical help to open these roads in July, 1952, so the summer operations would not be delayed.

Although snow is our stock in trade at the Central Sierra Snow Laboratory, we earnestly hope that we do not receive as much this year, as it is difficult to study a medium when you are constantly digging out of it.

EASTERN SNOW CONFERENCE

The tenth annual meeting of the Eastern Snow Conference will be held at Albany, New York, on February 12 and 13, 1953. The technical sessions and social gatherings will take place at the Ten Eyck Hotel. A feature of the meeting will be a tour of the General Electric Research Laboratory at nearby Schenectady and an address there by Dr. Irving Langmuir. All readers of WEATHERWISE are invited to attend.

This snow tractor was lost during one of the big storms of January, 1952. The top of the windshield was three feet below the surface, and it was necessary to probe the area with snow tubes to locate the buried vehicle. Dept. of Defense photo.

TIME TO FISH FOR TROUT

EDWIN L. COOPER
Pigeon River Trout Research Area, Vanderbilt, Michigan

The season opens early for Ralph J. Smith of Council Bluffs, Iowa. Courtesy of Field and Stream Magazine.

THERE is perhaps no sport other than fishing that has associated with it such a multitude of superstitions, old wives' tales, and pure notions. Many of these are claimed to be founded on scientific facts, yet a search of reputable fishery literature fails to yield much concrete evidence either in favor or in contradiction of such claims. At the present time not a few persons are capitalizing on the well-known susceptibility of both fish and fishermen to lures and aids of various kinds. For the fisherman these include fishing calendars, fishing tables, barometers, thermometers and, looking a bit to the future, probably radar, sonar and Geiger counters.

The Pigeon River Trout Research Area was established in Michigan in 1949 as a Conservation Department installation. Its primary purpose was to obtain facts that were needed in the correct management of our natural resources associated with trout streams and lakes. Complete fishing records were made possible through a compulsory permit type of angling. Year-round field work supplementing the creel (fisherman's basket) census made possible an adequate evaluation of what is happening to the stocks of native trout and hatchery-reared trout in the stream. In order to provide answers to some other interesting questions concerning factors affecting fishing quality, observations of certain physical conditions have been maintained at the station. These include atmospheric pressure changes, air and water temperatures, and precipitation. A Weather Bureau cooperative observer has been stationed at this locality for many years.

The following discussion of the influence of various factors on fishing is based on detailed records of over 7,000 fishing trips made dur-

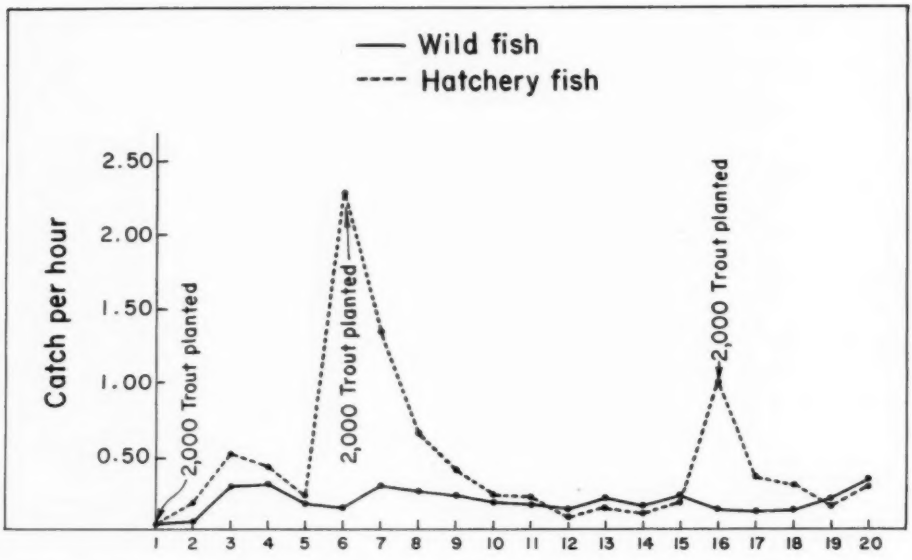


Fig. 1. The relationship between time of planting and catch per hour of hatchery trout planted in the Pigeon River and wild trout during the 20 weeks season of 1950.

ing the seasons of 1949, 1950 and 1951. These are concerned entirely with fishing for the three species of stream trout found in Michigan: brook, brown and rainbow. No selection of individuals was made in issuing permits to the stream, and many states other than Michigan were represented by anglers. It is believed that the sample of angling represents an accurate cross-section of the trout fishing fraternity.

The basis for comparing fishing quality used in this study is the number of trout caught per hour per fishing trip. This type of computation enables one to apply statistical procedures to obtain estimates of the reliability of differences noted. These data have been transformed to the numbers of fish caught per hundred hours of angling for convenience in handling the figures. Another index of fishing quality used is the percent of successful fishing trips, a successful trip being one in which at least one fish is caught.

Both naturally spawned trout and hatchery-reared trout were caught by fishermen in the Pigeon River. Because of the marked effect of planting legal-sized trout on the catch per hour (Figure 1), it has been very difficult to evaluate the effects of other factors on fishing when hatchery fish are included. The catch of wild fish in the stream, however, is more constant throughout the season, and this fact makes possible a determination of the effects of other physical factors on fishing quality.

The records of fishing have been tabulated according to days in which the atmospheric pressure was steady, rising, or falling; a steady day being one in which there was less than 0.1 inch pressure change in a 24-hour period. Fishing was slightly better when the barometer was rising, although the difference was so slight as to be unnoticeable to the angler (Figure 2).

Similar comparison of fishing quality was made according to the phase of the moon. The synodical period was divided into four phases with the odd days added to the full moon and the new moon phases. In this comparison a slight increase in fishing quality was noted when the moon was in the first quarter, although again this difference was too slight to be noticeable to the average angler (Figure 2).

Because of the early opening of Michigan's trout season (last Saturday in April), oftentimes there is still snow on the ground, and water temperatures are noticeably cool. The spring of 1950 was one of these abnormally cold openings, and fishing quality during this

cold period was very poor. This observation prompted an analysis of the effect of water temperature on fishing quality over the range of temperatures normally found in a trout stream during the open season. Such an analysis indicated that fishing was best when the daily maximum water temperature was between 55° F. and 74° F., whereas temperatures above or below these values apparently had an inhibiting effect on feeding (Figure 2). Fishing when water temperatures remained below 50° F. produced almost nothing, the catch per hundred hours being about two fish.

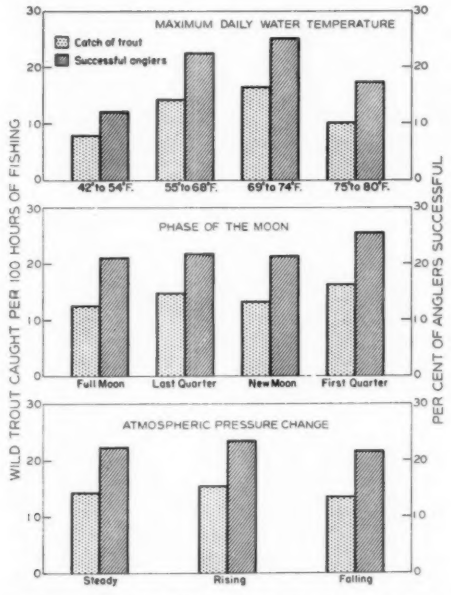


Fig. 2. The relationship between fishing quality and water temperatures, lunar cycles and atmospheric pressure changes for trout fishing in the Pigeon River, 1949–51.

These observations are in agreement with detailed studies of optimum temperatures for good growth in trout in other parts of the country.

It should be emphasized that these data are based on averages obtained from a large sample of anglers. These anglers by no means are equal in their ability to catch fish. A tabulation of the fishing records of individuals for the three years indicates that a small number of individuals account for a "lion's share" of the catch. Even though 4,500 legal-sized trout were planted each year in two and one-half miles of stream, roughly half of the anglers took no fish and four percent of the best anglers accounted for 40 percent of the total catch. For wild fish, over 75 percent of the anglers took no fish.

There are many factors that influence the quality of fishing, and it has not been possible as yet to obtain information on many of them. Of the conditions that have lent themselves to accurate measurement and evaluation, however, it is obvious that atmospheric pressure changes and lunar periods are perhaps the least in importance of any that we have studied. Since trout fishing is a highly individualized sport, the psychological attitude of the angler is an important consideration. Consequently anything that gives the angler more confidence in his own ability to catch fish very probably actually increases his fishing success. If you want to catch fish, there is no substitute for "know-how" and that includes much information which the trout fisherman is loath to divulge. It is perhaps in this field of black magic that the fishery biologist has no right to explore for fear of being labeled a meddler or spoilsport. The best time to go fishing apparently is when you have the opportunity.

RAIN–MAKING

The U. S. Weather Bureau has announced plans for a full-scale project to test the validity of current theories and the feasibility of current methods employed in rain-making. The stated objectives are to study the mechanism of natural precipitation and the effect of artificial nucleation on cloud structures and precipitation in migratory cloud systems.

The experimental area during the first phases of operations will be the southwestern portion of the state of Washington and a nearby part of Oregon, the area west of the Cascade and Olympic ranges. Headquarters have already been established at the Sand Point Naval Air Station near Seattle. Other agencies who will assist in the operations and supply equipment are the U. S. Navy, U. S. Army Signal Corps, the National Advisory Council on Aeronautics, Civil Aeronautics Authority and Air Navigation Development Board. Field operations are expected to commence in February, 1953.

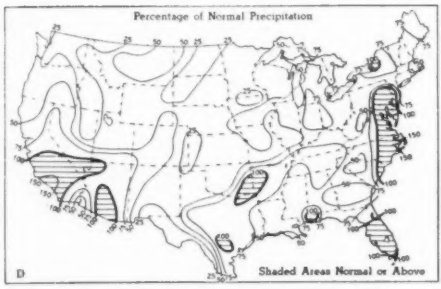
Weatherwatch

WINTER STARTS ON A MILD NOTE

DAVID M. LUDLUM, *Editor*

THE circulation pattern of the early fall drought, which was the most widespread the nation has ever experienced, continued through the first week of November. A strong ridge over the Plateau and Pacific states caused an uninterrupted flow of dry west-northwest winds over the Northwest and the eastern two-thirds of the country. Finally, after nine weeks of severe drought that brought two almost rainless months to much of the West, the ridge began to flatten out, permitting moist Pacific air to flow through Oregon and Washington as a deep trough approached the coastline. This trough, an offshoot from an intense Aleutian low, proved to be the main weather feature of the month, as it brought nationwide storminess to the country for the first time since spring.

After the trough passed eastward, the Pacific ridge rebuilt and continued to pour a northwesterly flow into the central and eastern sections which were experiencing trough conditions. A blocking ridge in the Atlantic Ocean assumed importance as the month developed. It forced storm centers in the United States northward, a condition that brought mild maritime air to much of the Northeast and Great Lakes region and kept temperatures throughout the month at relatively high levels. In fact, north of a line from North Dakota to the Carolinas, the mercury was much above normal, while to the south and west readings were below normal and much below in parts of the Plateau and central Rockies. Precipitation was heavy in the trough from southern California eastward to Texas and thence northeastward to the Lakes, and also heavy in the Middle Atlantic states, principally due to the storm of the 20–23rd.



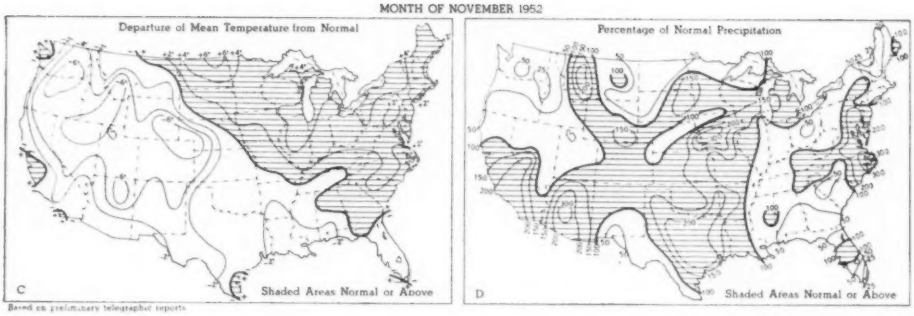
The percentage of normal precipitation, September–November, 1952, showing the widespread nature of the drought. USWB chart.

END OF DROUGHT—The first significant break in the long rainless period came on November 4th when a small area in New Mexico and west Texas received about a quarter-inch of rain as a cold front passed. The wet area worked eastward, reaching southern Alabama on the 6th and ending the 45-days rainless period in Louisiana and Mississippi, the second longest on record.

Another cold front moved southward from Canada on the 7th, and a rain area broke out over the central Mississippi Valley with 0.31 inches falling at Kansas City and similar amounts eastward through the Ohio Valley on the 8th. A secondary developed on the cold front in the Texas Panhandle, and for the first time in many months moist air from the Gulf of Mexico was drawn northward and forced to rise over a substantial cold air mass, resulting in copious rains over the parched lands from southwest Texas northeastward. The heaviest amounts, over an inch, were reported from Abilene, Texas, to central Tennessee on the 9th and lesser amounts all the way to the Atlantic seaboard on the 10th.

The central and northern Rockies, as well as the central and northern Plains, did not receive relief until later. Precipitation started on the Northwest Coast on the 9th and continued daily, but it was not until the 12th that the rains pushed across the mountains to give respite to the areas that needed it the most. On the 13th a very intense cyclone with a center pressure at 28.70 inches appeared off the Washington coast, bringing rains on the 14th as far south as San Diego. As the moist air spread eastward behind the front, good rains fell over the Plateau on the 15–16th and over the Plains on the 17–18th. Some very heavy amounts were recorded in Iowa, Wisconsin and Michigan, as the complicated frontal system drew great quantities of maritime air northward from the Gulf.

AN INTENSE NOVEMBER STORM—The frontal system that had drawn the Gulf air northward and caused the heavy rains in the Mississippi Valley moved very slowly eastward on the 19th and was oriented on a north-south axis separating continental polar air in the west from maritime tropical air in the east. Several waves, as expected, developed on the front to increase air mass lifting and consequent precipitation. Early on the 20th the front stretched along the crest of the Appalachians with a wave formation evident in the western Carolinas. Another 24 hours brought the front to the seacoast of South Carolina, where still another wave formed that almost immediately became the main center of action. As the circulation intensified around the new center and it moved northwestward up the front, very moist air from


MONTH OF NOVEMBER 1952
Departure of Mean Temperature from Normal
C
Shaded Areas Normal or Above
Based on preliminary telegraphic reports
Percentage of Normal Precipitation
D
Shaded Areas Normal or Above
Commerce-Weather Bureau, Washington, D. C.

Departure in degrees Fahrenheit of the mean temperature, December, 1952, from the normal. USWB chart.

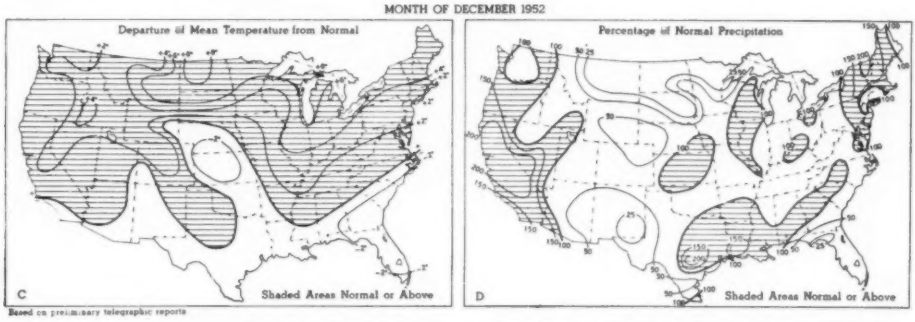
Percentage of normal precipitation, November, 1952. USWB chart.

the Atlantic Ocean spread westward aloft: Hatteras, N. C., had 9.40 inches of rain on the 19–22nd, and Mt. Mitchell, N. C., had 3.96 inches on the 20th alone.

Along the western slopes of the Appalachians in the Tennessee-Kentucky-Virginia triangle, temperatures were just at the freezing level, and the precipitation fell as a very moist snow. Knoxville, seat of the TVA, received 2.66 inches of melted precipitation. It was estimated that a total of 18.2 inches of wet snow fell there, although the maximum snow cover measured was only 10.0 inches. Mr. Kleinsasser of the Knoxville Weather Bureau office reported to WEATHERWISE that no snow fell 40 miles to the south of the station or 50 miles to the west. The lowest temperature during the period of snow was 31° F. The fall of 18.2 inches comprised the greatest 24-hour fall since records were begun at Knoxville, and one of the heaviest in all Tennessee history. The greatest previous November snowstorm at Knoxville was in 1950, when 5.5 inches fell in one day.

At this point the low center began to exhibit many similarities to the Great Appalachian Storm of November, 1950. The path of the center was much the same in its movement from the Carolinas north-northwestward to Ohio and thence to Hudson Bay. Strong winds covered the eastern slopes of the mountains and heavy rains fell in the Middle Atlantic and New England states to replenish ground water that had all but disappeared in the long dry period. But the clash of weather elements in the 1952 storm were hardly of the same order as occurred in 1950. The main element lacking was an intense anticyclone in the Mississippi Valley with a great reservoir of cold air, an essential for quick deepening of an Atlantic Coast storm. Nevertheless, the 1952 storm will be a memorable one, for the frontal system that had entered the Pacific Coast on the 13th dominated the circulation pattern of the country for ten days and brought final relief to all areas from the most widespread drought in the nation's history. It was a billion dollar storm in its beneficial effects.

A WARM BLIZZARD—A South Pacific low took form over the Southwest on the 22nd to start the elements in motion for the second major disturbance of the month. An almost stationary frontal system lay along the Mexican border on which a circulation developed in Arizona late on the 23rd. Heavy rains soon fell over Texas and



Departure in degrees Fahrenheit of the mean temperature, December, 1952, from the normal. USWB chart.

Percentage of normal precipitation, December, 1952. USWB chart.

moderate amounts to the north and west as tropical air streamed inland from the Gulf of Mexico. Widespread rains and snows broke out all over the Plains and northeastward to the Great Lakes on the 24th, though the low center was still indistinct over the Texas Panhandle. Then cold air was drawn southward along the western Plains; when it entered the circulation, the center deepened rapidly and moved off at a quick pace northeastward. A very tight pressure gradient developed and strong winds began to sweep the Plains, driving a heavy snow. The storm was called a "warm blizzard" because it had all the characteristics of a true blizzard except low and falling temperatures. The mercury remained generally in the middle twenties throughout the storm. Winds were clocked up to 60 mph. in the northwest quadrant, and snow fell to the depth of 10 inches in a long band from Amarillo, Texas, northeastward to Wisconsin.

The intense circulation of the blizzard low dominated the weather of the eastern two-thirds of the country for the remainder of the month. The low center, blocked from a normal northeastward track, continued northward to Hudson Bay, and this position permitted cold air masses over western Canada to rush southward with an early cold wave resulting in the Rockies and Plains. The mercury dropped to −37° at Bondurant, Wyo.; to −36° at West Yellowstone, Mont.; and to −35° at Gavilan, N. M., on the 26–27th. At Goodland, Kansas, a new early season minimum of −12° was registered, and the freezing line was pushed to the Rio Grande Valley in Texas.

DECEMBER—The main feature of the circulation in December was an intensifying of the blocking action in the North Atlantic Ocean that had begun to influence storm movements in the last half of November. A persistent ridge extended from southern Greenland southward in the area that is usually the haunt of the Icelandic low, which was considerably less intense than normal. The Bermuda high, too, was rather weak and displaced northward. This pressure pattern, with westerly control at a minimum, favored a southeasterly flow of maritime Atlantic air over the northeastern United States and eastern Canada that reached well into the Arctic. As a result, much above normal temperatures were reported from northern Canada southward to include northern and central United States.

In the Far West the pressure pattern, with only a flat ridge in the Plateau, also favored the influx of maritime air, this time from the Pacific, into the prairie provinces and northern United States. With low pressure extending all across Canada, not a single important anticyclone appeared in the Mackenzie-Yukon region, the breeding place of our winter cold waves. It was a different story across the pole in Siberia! Pressure there was abnormally high throughout the month, the cold was intense, and all Europe and Asia had a wintry month as a result of the outflow from the vast Siberian high. Korea suffered, in particular, as the northwest flow pushed the polar front southeastward into the Pacific Ocean.

A TRANSCONTINENTAL STORM—The only noteworthy disturbance of the month in the United States entered the Northwest Coast over Washington early on the 7th, as an offshoot of an intense Aleutian low centered off British Columbia. Its passage inland was attended by heavy rains. Eureka, Cal., had 2.56 inches on the 6th and heavy snows fell in the Cascades and Siskiyou range. The Mt. Shasta area was snowed in, and communications were cut off between Oregon and California for a number of hours, to remind Californians of the January, 1952, snowbound trains at Donner Summit.

The storm moved eastward at an average rate to a location just north of Minnesota at noon of the 9th. Then the blocking action in the Atlantic ridge made itself evident, turning the center directly northward while the movement of the cold front dropped to a very slow pace. A wave soon formed on the front in Missouri as very moist air in advance came into close proximity with dry air to the west. At the same time a complicated warm front took shape over the Appalachians in Pennsylvania and West Virginia, separating tropical air in the interior valleys from polar air that overlay the coastal states north of Virginia.

Another 24 hours, as the cold front from the west pinched out the warm front, saw a secondary development in southern Virginia. The circulation around the secondary center soon became intense with vast quantities of moist air from the Atlantic Ocean being brought into the whirl, helped along by the general southeasterly drift set up by the blocking ridge in the Atlantic. By noon of the 11th heavy rains were falling all along the Appalachians with amounts ranging from one to one-and-a-half inches. The Virginia secondary moved slowly northeastward rather close to the shoreline and was over Rhode Island at 1:30 a.m. of the 12th. Now excessive rains were falling over the northern Appalachians and New England: Albany 3.16 inches in 24 hours and Hartford 2.08 inches.

The cold front south of the storm center swung at a good pace out to sea in the usual manner, but the northern portion of the front, tied to the original storm center now over Hudson Bay, was reluctant to move eastward, as it was bucking the high pressure ridge over Labrador and Greenland. From the Rhode Island center, the front extended northward early on the 12th through New Hampshire and thence westward to Hudson Bay. Still at a slow pace, the center moved up the front, and 24 hours later had progressed only to the Maine-Quebec border near Jackman, Maine. All the while warm air was streaming in from the Atlantic over the maritime provinces and Quebec to warm further the sub-Arctic. To illustrate the differences in air circulation, Quebec City had 38° and rain, while Montreal, though 150 miles to the southwest, had 28° and snow at the same observation time. There were heavy December rains over Maine, but further west in Vermont and New

York it was all snow—28 inches at Lake Placid and 24 inches at Saranac Lake.

The westward-curving low continued for another 24 hours, taking a retrograde motion to a point near the Quebec-Ontario border just to the south of James Bay. Finally, on the 15th, the center was caught in the now westerly circulation across central Canada and moved off to the northeast after being the center of the nation's weather picture for more than a week.

THE FLORIDA FREEZE—While the Arctic was basking in abnormal warmth, the agricultural areas of the Florida peninsula experienced an "unusual" freeze. Twice within a week a high pressure area stalled over the Middle Gulf region to draw cool air southward into the rich winter citrus and truck areas. In north Florida on the 12th temperatures were from 27° to 33°, with some low spots at 25°, and heavy frost formation. In the Everglades, far to the south, readings were generally 35° to 38° near the lake, 31° to 37° a short distance from the lake with light frost, and 25° to 28° in some low spots away from the lake with moderate to heavy frost.

Again on the 16–17th temperatures fell to low figures in both northern and southern Florida. They were 22° to 29° with heavy frost in the north with heating of orchards required. In the Everglades temperatures ranged from 28° to 36° with some low spots at 25°. On the lower East Coast the mercury fell to 31° to 36° with frost away from the coast as far south as the latitude of Miami.

There appears to have been little damage to citrus fruits since temperatures did not stay below critical levels for any extended time. In fact, the freeze was considered to be beneficial in coloring and sweetening the fruit. Damage to truck crops, however, was rather severe. Hundreds of acres of beans and some potatoes were killed as far south as the Everglades.

An interesting meteorological situation during the freeze has been pointed out to WEATHERWISE by Warren O. Johnson, meteorologist in charge of the Lakeland office: "On the morning of December 13th there occurred in Florida a rather unusual situation. The peninsula experienced frost in northern Florida and in southern Florida with temperatures down to as low as 29° in the north and to 30° to 35° south of Lake Okechobee. At the same time, it was cloudy and raining (light) with temperatures 35° to 46° in central Florida—a narrow band extending from near Tampa to Titusville. Quite frequently we can have frost in north Florida and in the Everglades and even the lower East Coast and not have any frost in the central part. However, I do not ever recall having rain in the central portion of the state with frost on both sides of the rain area."

HOLIDAY WEATHER—Christmas Day was generally fair over the nation with temperatures at seasonal levels except in the Northeast where they were on the mild side. Rains were confined to a small area in the Southeast, there were snow flurries in the Great Lakes, and light mixed precipitation fell in the Northwest.

Eric Sloane's Weather Book. ERIC SLOANE. Little, Brown & Company—and Duell Sloane and Pierce, Boston and New York, 1952. 90 pages. $3.75.

There is a definite need for the public to become more weather conscious. It is not enough that they merely may be interested in the weather without understanding the basic laws of its behavior. Many lives are lost each year simply through lack of attention to developing weather conditions. Several elk hunters were lost in my own state of Arizona last fall in a snowstorm whose approach was known well ahead of the opening day of the season. Eric Sloane's Weather Book will definitely make those readers who have been interested in the subject become weatherwise, and this is the first step to becoming fully weather conscious.

This book is authoritative. It is well-based academically without being stiff and formal, and it is delightful reading. Mr. Sloane's style and approach to the subject are cheerful with a definite lilt to his prose. He talks directly to the reader as though in personal conversation, and this makes for a certain charm in his presentation.

The author's sketches, which are well known to readers of WEATHERWISE, are definitely original and artistic, many of them adding a new clarity to the otherwise puzzling vagaries of the atmosphere. These personal drawings add greatly to the quick understanding of the accompanying text.

The book deals with the physical principles that are the basis of modern meteorology. It covers the field without dodging any of the major issues, yet does not involve the reader in complicated mathematical equations and technical theories. To present this difficult subject in such a manner that the layman can master the basic principles "without a struggle" is an achievement of high order.

The book explains many of the common weather phenomena and points out both fact and fiction of a number of traditional weather beliefs and sayings. In fact, a student of the book can become an adequate short-range forecaster with a little practice and experience. The reviewer would like to hazard the forecast that Eric Sloane's Weather Book will enjoy a widespread acceptance among all who wish to have their path to a better understanding of the weather made more easy.

It is customary for reviewers to dig out and hold up for exhibit slips of the type or pen, but I prefer to leave any such criticisms to the reading public and to merely comment: "It is right good reading."

JAMES R. WILSON
Phoenix Union High School
Phoenix, Arizona

Wind, Storm and Rain. The Story of Weather. DENNING MILLER. Coward-McCann, Inc., 1952. 177 pages. $3.95.

This is the most literate and readable book on the weather that has come to the attention of *551.5* since the inception of this department of *WEATHERWISE*. The author, a World War II navigator, has been able with his facile pen to steer through the intricacies that plague our science of meteorology and in ten essay-like chapters present an interesting and authoritative discussion of the weather world. Mr. Denning's book will delight those who like to read about modern science and yet relax at the same time.

This is no textbook. Each chapter can stand by itself and would make good popular magazine articles. The author is well-versed with his subject and brings to his discussion much of post-war thinking about the general circulation, the jet stream, long-range forecasting and artificial rain increasing. The chapter on the jet stream is probably the best in the book and can be read with profit by all fellow scientists who wish to be abreast of this latest concept that promises much for the future improvement of forecasting.

May we have more books on meteorology by Mr. Miller and by those who can match his literary ability. D. M. L.

Meteorology. An Elementary Textbook. JAMES R. WILSON AND R. J. HANNELLY. Printery Publishing Company, Phoenix, Arizona, 1951. 92 pages. $3.20 (To schools and libraries: $2.40).

There have been many high school textbooks in meteorology planned, but this volume is the first, to the reviewer's knowledge, that has ever issued from a press. The current work is based on the two authors' experiences in teaching a course in elementary meteorology that has been given in the regular curriculum at the Phoenix Union High School.

Five years' teaching experience has gone into streamlining the text so as to make it understandable at the average high school student's level. The vocabulary has been well adjusted to this view.

The text proceeds from a discussion of the physics of the air, to a consideration of air masses and fronts, and then treats of the movement of storms and reading the weather map. Concluding chapters cover briefly the subject of artificial precipitation, of great importance to the authors' area, and the various climate types of the world, showing how Arizona fits into the picture.

Objective tests are being prepared to accompany the book, and a companion workbook has been promised. There are many unique illustrations and new photographs, all by the authors. D. M. L.

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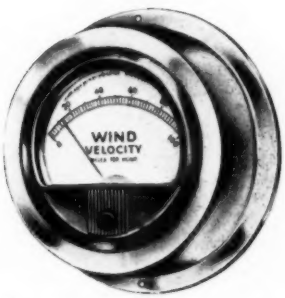

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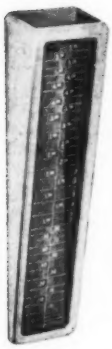

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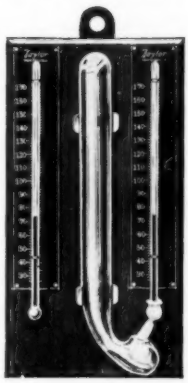

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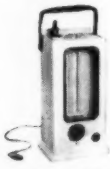

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